Case Study

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# Monitoring Long-term Steam Chest Development during Thermal Operations in Northern Alberta

**ESG continuously monitored a thermal recovery operation in the heavy oil sands of Alberta. Analyzing microseismic data collected over eight years provides a valuable time-lapse image of steam chamber development throughout the reservoir. Observing the steam chamber development aids in maximizing production and avoiding by-passed zones.**


Fig. 1: Location of the Peace River, Athabasca and Cold Lake Oil Sands areas in Alberta

The oil sands deposits found in northern Alberta are composed of sand, clay, water and bitumen, a highly viscous form of petroleum. Bitumen is too dense to flow naturally, and must be heated or diluted in order to flow. This unconventional oil deposit has only recently been accepted as an economical energy resource as a result of higher oil prices and advancements in technology such as Steam Assisted Gravity Drainage (SAGD) and Cyclic Steam Stimulation (CSS).

## Challenge

Oil sands operations are very costly and operators want to ensure that they maximize oil recovery. In particular, operators need to know that their steam stimulations are targeting the correct areas of the reservoir. Microseismic monitoring is often employed in these applications, as continuous event monitoring can produce the only time-lapse representation of how the

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reservoir is responding to operations.

## ESG Solution

ESG installed a permanent downhole microseismic monitoring system at a well pad in northern Alberta in 2002. Specifically, an eight-level toolstring consisting of triaxial sensors spaced 10 meters apart, was positioned in a deviated observation well on the north side of the pad (Figure 2-A). The well pad consisted of 30 horizontal treatment wells.

Since 2002, the client has performed cyclic steam stimulation injections to produce heavy oil from the wells. Microseismic monitoring is used to track the steam front by observing where fractures are created in the reservoir. A seismic deformation volume is calculated to determine the effective volume which will contribute the most to production.

Tracking the steam chamber during thermal operations is useful in identifying zones in the reservoir which have not been stimulated. In particular, the observation of by-passed zones such as the area in the left-hand center region of Figure 2-D can be targeted in subsequent steaming cycles, so that maximum production can be achieved.

The illustrations in Figure 2 shows the progression of steam chamber development using thermal methods for heavy oil production from A, the start in 2002 to D, in 2010. Note the halo effect with microseismicity defining the development of the steam chamber.

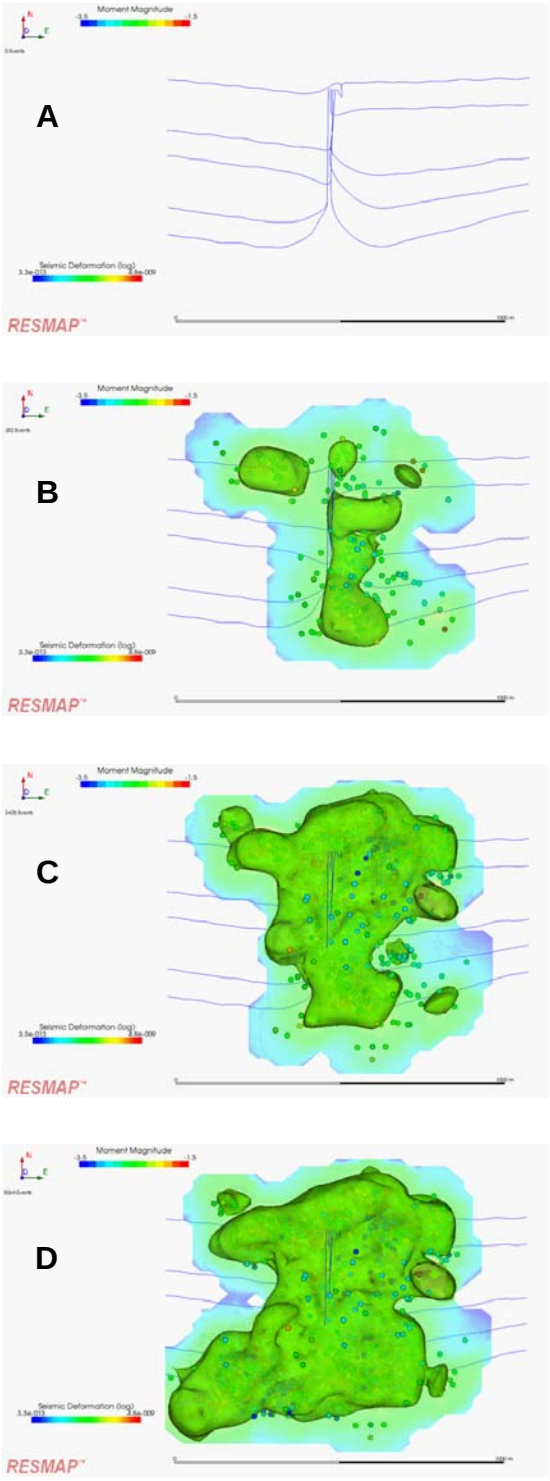


Fig. 2: Progression of a steam chamber using thermal methods for heavy oil production from 2002 to 2010.

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